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(54) Liquid crystal display device of optical writing type

Lichtadressierte Flüssigkristallanzeigevorrichtung

Dispositif d'affichage à cristal liquide adressé optiquement

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a liquid crystal display device of optical writing type.

2. Description of the Related Art

As one of various kinds of liquid crystal display devices, there is a liquid crystal display device of optical writing type, which is typically used as a liquid crystal light valve.

Such a liquid crystal display device of optical writing type includes a pair of glass substrates facing each other.

Each of the substrates is provided with a transparent electrode on the facing side.

On the first transparent electrode, there is formed a photoconductive layer. The photoconductive layer is made from hydrogenated amorphous silicon (a-Si:H).

On the photoconductive-layer, there is formed a dielectric mirror layer. The dielectric mirror layer is made from multiple layer films composed of Si (silicon)/SiO_2 (silicon dioxide),TiO_2 (titanium dioxide)/SiO_2, or ZnS (zinc sulfide)/MgF (magnesium fluoride), etc..

Between the photoconductive layer and the dielectric mirror layer, there may be interposed a light absorbing layer. The light absorbing layer is made from a patternized thin film including C (carbon), Ag (silver) and so on.

A pair of orientation films are formed on the dielectric mirror layer and the second transparent electrode. A liquid crystal layer is disposed between the orientation films and sealed by use of a sealing member which functions as a spacer and attaches the glass substrates to each other.

Such a liquid crystal display device is used as a liquid crystal light valve, for example, for use in a liquid crystal projector.

In the operation of the liquid crystal display device as a light valve, an alternating electrical voltage is applied accross the transparent electrodes. Then, a laser beam scans the substrate from the side of the photoconductive layer so as to change the impedance of the photoconductive layer, change the voltage applied to the liquid crystal layer, and change each molecular orientation of the voltage applied area of the liquid crystal layer. Thus, an image due to the impedance differences of the photoconductive layer is achieved on the liquid crystal layer, depending on the condition of the photoconductive layer, i.e. whether it is in a dark condition (where the laser beam is applied) or a bright condition (where the laser beam is not applied).

In the case of utilizing such a light valve for a liquid crystal projector, the written image on the liquid crystal layer is projected onto a screen by use of projection light from a light source.

As operation modes in such a display operation, there are TN (twisted nematic) mode, HFE (hybrid field effect) mode, GH (guest host) mode, phase transition mode and so on.

In this kind of liquid crystal display device of optical writing type, since a hydrogenated amorphous silicon layer is used as the photoconductive layer, the conductivity of the photoconductive layer in the dark condition is of the same order as the conductivity of the liquid crystal layer, which is about 10^{-10} to 10^{-12} S/cm. The impedance of the photoconductive layer and the liquid crystal layer are of the same order. Accordingly, on the one hand, even in the dark condition, a certain amount of the voltage is applied to the liquid crystal layer. On the other hand, in the bright condition, the impedance of the photoconductive layer is reduced to be lower than the impedance of the liquid crystal layer, resulting in that substantially the whole voltage is applied to the liquid crystal layer. In this structure, the so called ON/OFF voltage ratio, which is the ratio of the voltage applied to the liquid crystal in the light applied area to the voltage applied to the liquid crystal in the light not applied area, is lowered because a certain amount of the voltage is applied to the liquid crystal layer even in the dark condition, resulting in an increase of the OFF voltage. Consequently, there is a problem of this kind of liquid crystal display device that a high contrast image can not be obtained.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a liquid crystal display device of optical writing type which can create a high contrast image.

In one aspect the present invention, as defined by Claim 1, provides a liquid crystal display device of the optical writing type, comprising:

a first transparent substrate;
a first transparent electrode formed on said first transparent substrate;
a single photoconductive layer formed on said first transparent electrode;
a second transparent substrate;
a second transparent electrode formed on said second transparent substrate; and
a liquid crystal layer disposed between said photoconductive layer and said second transparent electrode,
characterized in that said single photoconductive layer comprises hydrogenated amorphous silicon carbide.

The preamble of Claim 1 reflects the state of the art according to WO 89/02094, which discloses a liquid crystal light valve having a single photoconductive layer

comprising amorphous silicon, deposited by plasma CVD method.

In the liquid crystal display device according to the present invention, the single photoconductive layer comprises hydrogenated amorphous silicon carbide. Such a photoconductive layer can be formed, for example, by means of a CVD method, a sputtering method, or a vacuum deposition method by use of material gas including silane (SiH_4), hydrogen (H_2), and methane (CH_4). The conductivities of the photoconductive layer in dark and bright conditions can be determined to desirable values by controlling the gas flow volume ratio of the material gas.

Thus, the impedance of the photoconductive layer in the dark condition is made higher than the impedance of the liquid crystal layer. On the contrary, the impedance of the photoconductive layer in the bright condition is made lower than the impedance of the liquid crystal layer. Accordingly, when a voltage is supplied across the first and the second transparent electrodes, in its operation, the voltage is hardly applied to a portion of the liquid crystal corresponding to a portion of the photoconductive layer in the dark condition. On the other hand, most of the voltage is applied to a portion of the liquid crystal layer corresponding to a portion of the photoconductive layer in the bright condition. Consequently, a large value of the ON/OFF voltage ratio can be achieved, and a great change in optical condition of the liquid crystal layer can be achieved. Thus, by scanning the photoconductive layer by a light for optical writing such as a laser beam, a high contrast display image can be produced by the display device of the present invention.

In another aspect, a method of manufacturing a liquid crystal display device is defined by Claim 8.

The dependent Claims 2 to 7, 9 and 10 relate to preferred features of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic cross sectional view showing a first embodiment of the present invention;

Fig. 2 is a graph showing a relationship between the molar composition and the conductivity of hydrogenated amorphous silicon carbide;

Fig.3 is a graph showing a relationship between the gas flow volume ratio of the material gas and the composition of the produced hydrogenated amorphous silicon carbide in its production process;

Fig.4 is a schematic plan view showing a second embodiment utilizing the first embodiment of the present invention;

Fig.5 is a schematic cross sectional view showing a third embodiment of the present invention; and

Fig.6 is a schematic cross sectional view showing a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will be described below with reference to the accompanying drawings.

Fig.1 shows a liquid crystal display device of a first embodiment according to the present invention.

In Fig.1, a liquid crystal display device 10 of optical writing type is provided with glass substrates 11a and 11b.

Transparent electrodes 12a and 12b are disposed on the substrates 11a and 11b respectively. Each of the transparent electrodes 12a and 12b has a multiple layer structure including layers of ITO (indium tin oxide) transparent conductive films and layers of SnO_2 (tin oxide) transparent conductive films, and is formed by means of a sputtering technique.

A photoconductive layer 13 is disposed on the transparent electrode 12b. The photoconductive layer 13 is made of hydrogenated amorphous silicon carbide ($a\text{-}Si_{1-x}C_x:H$) so that the impedance of the photoconductive layer 13 changes by application of a light. The photoconductive layer 13 is formed by means of a plasma CVD (chemical vapour deposition) method using SiH_4 (silane) gas, H_2 (hydrogen) gas, and CH_4 (methane) gas as material gases. The thickness of the photoconductive layer 13 is about 3 μm.

A dielectric mirror layer 14 is disposed on the photoconductive layer 13. The dielectric mirror layer 14 has a multiple layer structure including silicon films and silicon dioxide films, is formed by means of the sputtering technique.

Orientation films 15a and 15b are disposed on the transparent electrode 12a and the dielectric mirror layer 14 respectively. Each of the orientation films 15a and 15b is made of polyimide film which is formed by means of a spin coating technique and is applied with a molecular orientation by means of a rubbing technique.

The substrates 11a and 11b are attached together by a sealing member 16 which also serves as a spacer prescribing the distance between the substrates 11a and 11b.

A liquid crystal layer 17 is disposed between the orientation films 15a and 15b. The liquid crystal layer 17 is formed by pouring and sealing a composite nematic liquid crystal, which is made by adding chiral material (S811:made by Merck Co., Inc.) by about 10 weight % to nematic liquid crystal in phenylcyclohexanone family. The thickness of the cell of the liquid crystal is about 6 μm.

A phase transition mode is used as the display mode of the display device 10.

The operation of the display device will be explained below.

The conductivity of the hydrogenated amorphous silicon carbide as the photoconductive layer 13 changes in a great degree depending on the molar composition

X of the carbon in the hydrogenated amorphous silicon carbide (a-$Si_{1-x}C_x$:H).

Fig.2 is a graph showing a relationship between the molar composition X and the conductivity of the hydrogenated amorphous silicon carbide (a-$Si_{1-x}C_x$:H)

In Fig. 2, the line L1 shows a conductivity in the bright condition, and the line L2 shows a conductivity in the dark condition. As clearly shown from Fig.2, as the composition X increases, the conductivities in both bright and dark conditions decrease.

In order to selectively apply and not apply the electric voltage to the liquid crystal layer 17 by the difference in the condition of the photoconductive layer 13 between the dark condition and the bright condition, it is required to adjust the conductivities of the liquid crystal layer 17 and the photoconductive layer 13. Namely, it is preferable to make the conductivity in the dark condition of the photoconductive layer 13 lower than the conductivity of the liquid crystal layer 17 and to make the conductivity in the bright condition of the photoconductive layer 17 higher than the conductivity of the liquid crystal layer 17.

An example is explained hereinbelow, which uses a liquid crystal having a conductivity of 10^{-10} S/cm for the liquid crystal layer 17, since the conductivity of the liquid crystal layer 17 is within a range of about 10^{-10} to 10^{-12} S/cm as mentioned before.

In order to make the conductivity in the dark condition of the photoconductive layer 13 lower than 10^{-10} S/cm which is the conductivity of the liquid crystal layer 17, the composition X is to be higher than about 0.05 with reference to the line L2 of Fig.2.

On the other hand, in order to make the conductivity in the bright condition of the photoconductive layer 13 higher than 10^{-10} S/cm, the composition X is to be lower than about 0.5 with reference to the line L1 of Fig.2.

Accordingly, the composition X is preferably set in a range of about 0.05 to 0.5. If the composition X is not in this range, a high contrast image can not be achieved because the ON/OFF voltage ratio is made small. Further, in order to achieve a higher contrast image, the composition X is set so that the conductivity in the dark condition of the photoconductive layer 13 is more reduced while the conductivity in the bright condition is more increased.

If a liquid crystal of a conductivity different from 10^{-10} S/cm is used for the liquid crystal layer 17, the composition X can be determined in a same way as explained above.

The composition X can be adjusted by the gas flow volume ratio of the material gases, i.e. the SiH_4, H_2, CH_4 gases. Fig.3 is a graph showing the relationship between the gas flow volume ratio $CH_4/(SiH_4 + CH_4)$ and the composition X.

In Fig. 3, it is shown that the composition X monotonically changes as the gas flow volume ratio changes. Thus, it is possible to obtain the hydrogenated amorphous silicon carbide having a desirable composition X by adjusting the gas flow volume ratio.

An operation of thus constructed display device 10 will be explained with reference to Fig. 1 hereinbelow.

In the operation of the display device 10 as a light valve, an alternating electrical voltage is applied across the transparent electrodes 12a and 12b by an alternating voltage source 18. Then, a laser beam L scans the substrate 11b so as to change the impedance of the photoconductive layer 13, change the voltage applied to the liquid crystal layer 17, and change each molecular orientation in the voltage applied area of the liquid crystal layer 17 to a specific direction so as to change the polarization direction of an incident reading light R_1. Namely, in the area of the photoconductive layer 13 where the laser beam L is applied, the impedance of the photoconductive layer 13 is decreased and substantially whole voltage due to the voltage source 18 is applied to the liquid crystal layer 17, while in the area of the photoconductive layer 13 where the laser beam L is not applied, the impedance does not change and thus the voltage due to the voltage source 18 is not applied to the liquid crystal layer 17. Thus, an image due to the impedance differences is achieved on the liquid crystal layer 17, depending on the condition of the photoconductive layer 17 which is in either the dark condition or the bright condition.

While such an image is formed on the liquid crystal layer 17, the light R_1 is incident on the display device 10. The light R_1 is transmitted through the liquid crystal layer 17 and reflected by the dielectric mirror layer 14 as a reflected reading light R_2. The light R_2 is then outputted from the display device 10.

The operational principle of the display device 10 will be explained in more detail with reference to a display apparatus including the display device 10 hereinbelow.

Fig.4 shows a liquid crystal display apparatus 40, as a second embodiment of the present invention, utilizing the above described display device 10 as a light valve for light modulation.

In the operation of the display apparatus 40, an image is formed on the display device 10 by applying the laser beam L through a lens 43. The light R_1 from the lamp 44 is incident to the display device 10 through the lens 45 and a polarization beam splitter 47. Then, the light R_1 is reflected by the dielectric mirror layer of the display device 10.

Then, a portion of this reflected light passing through each portion of the liquid crystal layer of the display device 10, whose molecular orientation condition is changed by the laser beam L, is changed in its polarization direction due to the electro-optical effect of the liquid crystal layer 17. Thus, this portion of reflected light from the display device 10 can pass through the beam splitter 47 as the light R_2 of Fig.4 toward a lens 48.

On the other hand, another portion of the light R_1 passing through each portion of the, liquid crystal layer, whose molecular orientation is not changed by the laser beam L. is not changed in its polarization direction.

Thus, this other portion of light can not be reflected to pass through the beam splitter 47 toward the lens 48.

The light R_2 from the beam splitter 47 is magnified by the lens 48 and then projected onto a screen 46 as the image corresponding to the image formed on the display device 10.

As a material gas of carbon for forming the hydrogenated amorphous silicon carbide layer as the photoconductive layer 13, ethane, propane, butane, acetylene and so on, can be used other than the methane.

As a method of forming the hydrogenated amorphous silicon carbide layer as the photoconductive layer 13, the sputtering method, the heat CVD method, the light CVD method, ECR (electron cyclotron resonance) plasma method etc., can be utilized other than the plasma CVD.

The photoconductive layer 13 may be formed to include other materials such as oxygen and nitrogen.

Fig.5 shows a liquid crystal display device of a third embodiment according to the present invention.

In Fig.5, a liquid crystal display device 50 of optical writing type is provided with glass substrates 51a and 51b. The display device 50 has a similar structure as the display device 10 of Fig.1, except its structure that a dielectric mirror layer 54 is disposed on a left hand side of the liquid crystal 57 in Fig.5 while the dielectric mirror layer 17 is disposed on a right side of the liquid crystal 17 in Fig.1.

In the display device 50, transparent electrodes 52a and 52b are disposed on the substrates 51a and 51b respectively. A photoconductive layer 53 is disposed on the transparent electrode 52b. The dielectric mirror layer 54 is disposed on the transparent electrode 52a. Orientation films 55a and 55b are disposed on the dielectric mirror layer 54 and the photoconductive layer 53 respectively. The substrates 51a and 51b are attached together by a sealing member 56. The liquid crystal layer 57 is disposed between the orientation films 55a and 55b.

In an operation of the display device 50, a laser beam L is incident to the photoconductive layer 53.

Fig.6 shows a liquid crystal display device of a fourth embodiment according to the present invention.

In Fig.6, a liquid crystal display device 50 of optical writing type is provided with glass substrates 61a and 61b. The display device 60 has a similar structure as the display device 10 of Fig. 1, except its structure that a dielectric mirror layer is omitted.

In the display device 60, transparent electrodes 62a and 62b are disposed on the substrates 61a and 61b respectively. A photoconductive layer 63 is disposed on the transparent electrode 62b. Orientation films 65a and 65b are disposed on the transparent electrode 62a and the photoconductive layer 63 respectively. The substrates 61a and 61b are attached together by a sealing member 66. The liquid crystal layer 67 is disposed between the orientation films 65a and 65b.

In an operation of the display device 60, a laser beam L incident to the photoconductive layer 63. The display device 60 can be utilized as a display of a transmissive type or for objects other than display.

In the above described embodiments, nematic liquid crystal is used as the liquid crystal. However, this is not essential. Instead, the present invention can utilize smectic liquid crystal or ferroelectric liquid crystal.

In case that nematic liquid crystal is used, a field induced birefringence mode, the dynamic scattering mode the HFE mode, the GH mode, the phase transition mode, and the TN mode can be utilized as the display mode.

In case that smectic liquid crystal is used as the liquid crystal, the birefringence mode, the GH mode and the light scattering mode can be utilized as the display mode.

The invention may be embodied in other specific forms without departing from its scope as defined by the claims.

Claims

1. A liquid crystal display device (10;50;60) of the optical writing type, comprising:

   a first transparent substrate (11b;51b;61b);
   a first transparent electrode (12b;52b;62b) formed on said first transparent substrate;
   a single photoconductive layer (13;53;63) formed on said first transparent electrode;
   a second transparent substrate (11a;51a;61a);
   a second transparent electrode (12a;52a;62a) formed on said second transparent substrate; and
   a liquid crystal layer (17;57;67) disposed between said photoconductive layer and said second transparent electrode,
   characterized in that said single photoconductive layer (13;53;63) comprises hydrogenated amorphous silicon carbide.

2. A liquid crystal display device according to Claim 1 further comprising a first orientation film (65b) formed on said photoconductive layer (63), and a second orientation film (65a) formed on said second transparent electrode (62a), said liquid crystal layer (67) being disposed between said first and second orientation films.

3. A liquid crystal display device according to Claim 1 further comprising a dielectric mirror layer (14) disposed between said photoconductive layer (13) and said liquid crystal layer (17).

4. A liquid crystal display device according to Claim 3 further comprising a first orientation film (15b) formed on said dielectric mirror layer (14), and a

second orientation film (15a) formed on said second transparent electrode (12a), said liquid crystal layer (17) being disposed between said first and second orientation films.

5. A liquid crystal display device according to Claim 1 further comprising a dielectric mirror layer (54) disposed between said second transparent electrode (52a) and said liquid crystal layer (57).

6. A liquid crystal display device according to Claim 5 further comprising a first orientation film (55b) formed on said photoconductive layer (53), and a second orientation film (55a) formed on said dielectric mirror layer (54), said liquid crystal layer (57) being disposed between said first and second orientation films.

7. A liquid crystal display device according to Claim 1 adapted to operate in TN (twisted nematic) mode.

8. A method of manufacturing a liquid crystal display device of the optical writing type, comprising:

   forming a first transparent electrode (12b;52b; 62b) on a first transparent substrate (11b;51b; 61b);
   forming a single photoconductive layer (13;53; 63) comprising hydrogenated amorphous silicon carbide on said first transparent electrode, by means of one method selected from the group consisting of a CVD method, a plasma CVD method, an ECR plasma method, a sputtering method, and a vacuum deposition method;
   forming a second transparent electrode (12a: 52a;62a) on a second transparent substrate (11a;51a;61a); and
   disposing a liquid crystal layer (17;57;67) between said photoconductive layer and said second transparent electrode.

9. A method of manufacturing a liquid crystal display device according to Claim 8 wherein said photoconductive layer (13;53;63) is formed from a gas material including silane (SiH_4), hydrogen (H_2), and methane (CH_4).

10. A method of manufacturing a liquid crystal display device according to Claim 9 wherein the impedances in the dark and bright conditions are set to desired values by controlling the gas flow volume ratio of said gas material.

Patentansprüche

1. Lichtadressierbare Flüssigkristall-Anzeigevorrichtung (10; 50; 60) mit

   - einem ersten transparenten Substrat (11b; 51b; 61b);
   - einer ersten transparenten Elektrode (12b; 52b; 62b), die auf dem ersten transparenten Substrat ausgebildet ist;
   - einer einzelnen photoleitenden Schicht (13; 53; 63), die auf der ersten transparenten Elektrode ausgebildet ist;
   - einem zweiten transparenten Substrat (11a; 51a; 61a);
   - einer zweiten transparenten Elektrode (12a; 52a; 62a), die auf dem zweiten transparenten Substrat ausgebildet ist; und
   - einer Flüssigkristallschicht (17; 57; 67), die zwischen der photoleitenden Schicht und der zweiten transparenten Elektrode angeordnet ist;

   dadurch gekennzeichnet, daß die einzelne photoleitende Schicht (13; 53; 63) aus hydriertem amorphem Siliziumcarbid besteht.

2. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1, ferner mit einem auf der photoleitenden Schicht (63) ausgebildeten ersten Ausrichtungsfilm (65b) und einem auf der zweiten transparenten Elektrode (62a) ausgebildeten zweiten Ausrichtungsfilm (65a), wobei die Flüssigkristallschicht (67) zwischen dem ersten und zweiten Ausrichtungsfilm angeordnet ist.

3. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1, ferner mit einer dielektrischen Spiegelschicht (14), die zwischen der photoleitenden Schicht (13) und der Flüssigkristallschicht (17) angeordnet ist.

4. Flüssigkristall-Anzeigevorrichtung nach Anspruch 3, ferner mit einem auf der dielektrischen Spiegelschicht (14) ausgebildeten ersten Ausrichtungsfilm (15b) und einem auf der zweiten transparenten Elektrode (12a) ausgebildeten zweiten Ausrichtungsfilm (15a), wobei die Flüssigkristallschicht (17) zwischen dem ersten und zweiten Ausrichtungsfilm angeordnet ist.

5. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1, ferner mit einer dielektrischen Spiegelschicht (54), die zwischen der zweiten transparenten Elektrode (52a) und der Flüssigkristallschicht (57) angeordnet ist.

6. Flüssigkristall-Anzeigevorrichtung nach Anspruch 5, ferner mit einem auf der photoleitenden Schicht (53) ausgebildeten ersten Ausrichtungsfilm (55b) und einem auf der zweiten transparenten Elektrode (52a) ausgebildeten zweiten Ausrichtungsfilm (55a), wobei die Flüssigkristallschicht (57) zwi-

schen dem ersten und zweiten Ausrichtungsfilm angeordnet ist.

7. Flüssigkristall-Anzeigevorrichtung nach Anspruch 1, die so ausgebildet ist, daß sie im TN(verdrillt-nematischen)-Modus arbeitet.

8. Verfahren zum Herstellen einer lichtadressierten Flüssigkristall-Anzeigevorrichtung, umfassend:

 - Herstellen einer ersten transparenten Elektrode (12b; 52b; 62b) auf einem ersten transparenten Substrat (11b; 51b; 61b);
 - Herstellen einer einzelnen photoleitenden Schicht (13; 53; 63) aus hydriertem amorphem Siliziumcarbid auf der ersten transparenten Elektrode mittels eines Verfahrens, das aus der aus einem CVD-Verfahren, einem Plasma-CVD-Verfahren, einem ECR-Plasmaverfahren, einem Sputterverfahren und einem Vakuumabscheidungsverfahren bestehenden Gruppe ausgewählt ist;
 - Herstellen einer zweiten transparenten Elektrode (12a; 52a; 63a) auf einem zweiten transparenten Substrat (11a; 51a; 61a) und
 - Anordnen einer ersten Flüssigkristallschicht (17; 57; 67) zwischen der photoleitenden Schicht und der zweiten transparenten Elektrode.

9. Verfahren zum Herstellen einer Flüssigkristall-Anzeigevorrichtung nach Anspruch 8, bei dem die photoleitende Schicht (13; 53; 63) aus einem Gasmaterial hergestellt wird, das Silan (SiH_4), Wasserstoff (H_2) und Methan (CH_4) enthält.

10. Verfahren zum Herstellen einer Flüssigkristall-Anzeigevorrichtung nach Anspruch 9, bei dem die Impedanzen im hellen und dunklen Zustand dadurch auf gewünschte Werte eingestellt werden, daß das Gasströmungs-Volumenverhältnis des Gasmaterials eingestellt wird.

Revendications

1. Dispositif d'affichage à cristaux liquides (10; 50; 60) du type à enregistrement optique, comportant :

 un premier substrat transparent (11b; 51b; 61b);
 une première électrode transparente (12b; 52b; 62b) déposée sur ledit premier substrat transparent;
 une couche photoconductrice unique (13; 53; 63) déposée sur ladite première électrode transparente;
 un second substrat transparent (lla: 51a; 61a);
 une seconde électrode transparente (12a; 52a; 62a) déposée sur ledit second substrat transparent; et
 une couche de cristaux liquides (17; 57; 67) placée entre ladite couche photoconductrice et ladite seconde électrode, transparente,
 caractérisé en ce que ladite couche photoconductrice unique (13; 53; 63) comporte du carbure de silicium amorphe hydrogéné.

2. Dispositif d'affichage à cristaux liquides selon la revendication 1, comportant en outre un premier film d'orientation (65b) déposé sur ladite couche photoconductrice (63) et un second film d'orientation (65a) déposé sur ladite seconde électrode transparente (62a), ladite couche de cristaux liquides (67) étant placée entre lesdits premier et second films d'orientation.

3. Dispositif d'affichage à cristaux liquides selon la revendication 1, comportant en outre une couche miroir diélectrique (14) placée entre ladite couche photoconductrice (13) et ladite couche de cristaux liquides (17).

4. Dispositif d'affichage à cristaux liquides selon la revendication 3, comportant en outre un premier film d'orientation (15b) déposé sur ladite couche miroir diélectrique (14) et un second film d'orientation (15a) déposé sur ladite seconde électrode transparente (12a), ladite couche de cristaux liquides (17) étant placée entre lesdits premier et second films d'orientation.

5. Dispositif d'affichage à cristaux liquides selon la revendication 1, comportant en outre une couche miroir diélectrique (54) placée entre ladite seconde électrode transparente (52a) et ladite couche de cristaux liquides (57).

6. Dispositif d'affichage à cristaux liquides selon la revendication 5, comportant en outre un premier film d'orientation (55b) déposé sur ladite couche photoconductrice (53) et un second film d'orientation (55a) déposé sur ladite couche miroir diélectrique (54), ladite couche de cristaux liquides (57) étant placée entre lesdits premier et second films d'orientation.

7. Dispositif d'affichage à cristaux liquides selon la revendication 1, adapté pour fonctionner en mode TN (Twisted Nematic - Nématique en hélice).

8. Procédé de fabrication d'un dispositif d'affichage à cristaux liquides du type à enregistrement optique, comportant :

 le dépôt d'une première électrode transparente

(12b; 52b; 62b) sur un premier substrat transparent (11b; 51b; 61b);
le dépôt sur ladite première électrode transparente d'une couche photoconductrice unique (13; 53; 63) comportant du carbure de silicium amorphe hydrogéné, par l'un des procédés choisi parmi les suivants : procédé CVD, procédé CVD activé au plasma, procédé ECR activé au plasma, procédé de pulvérisation cathodique et procédé de dépôt sous vide;
le dépôt d'une seconde électrode transparente (12a; 52a; 62a) sur un second substrat transparent (11a; 51a; 61a); et
le placement d'une couche de cristaux liquides (17; 57; 67) entre ladite couche photoconductrice et ladite seconde électrode transparente.

9. Procédé de fabrication d'un dispositif d'affichage à cristaux liquides selon la revendication 8, dans lequel ladite couche photoconductrice (13; 53; 63) est déposée à partir d'un mélange gazeux comprenant du silane (SiH4), de l'hydrogène (H2) et du méthane (CH4).

10. Procédé de fabrication d'un dispositif d'affichage à cristaux liquides selon la revendication 9, dans lequel les impédances dans l'obscurité et à la lumière sont fixées aux valeurs souhaitées par commande du rapport volumique des composants dudit mélange gazeux.

Fig. 1

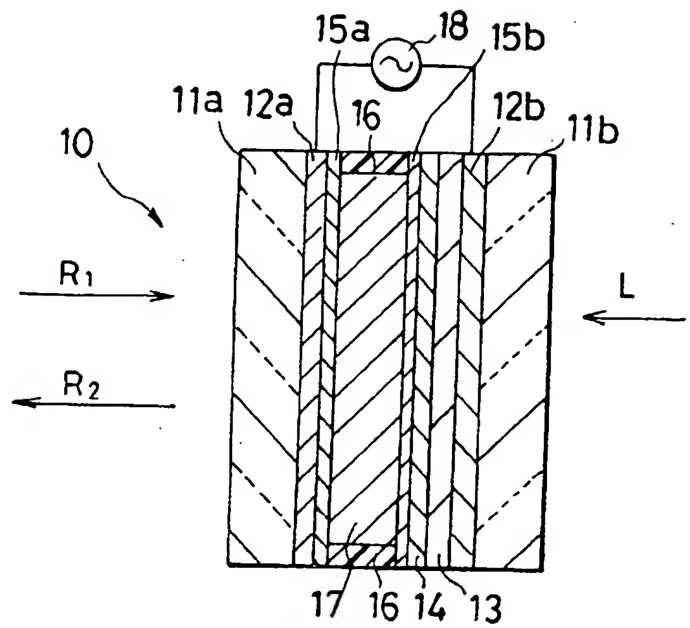

15a
18
15b
11a
12a
16
12b
11b
10
R1
L
R2
17
16
14
13

Fig. 2

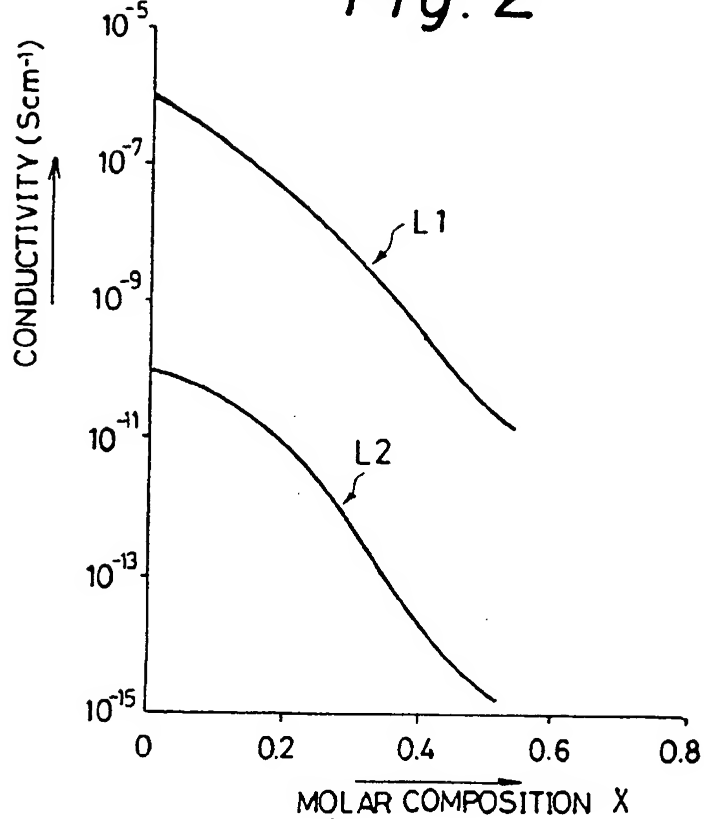

CONDUCTIVITY (Scm⁻¹)
10^-5
10^-7
10^-9
10^-11
10^-13
10^-15
L1
L2
0
0.2
0.4
0.6
0.8
MOLAR COMPOSITION X

Fig.3

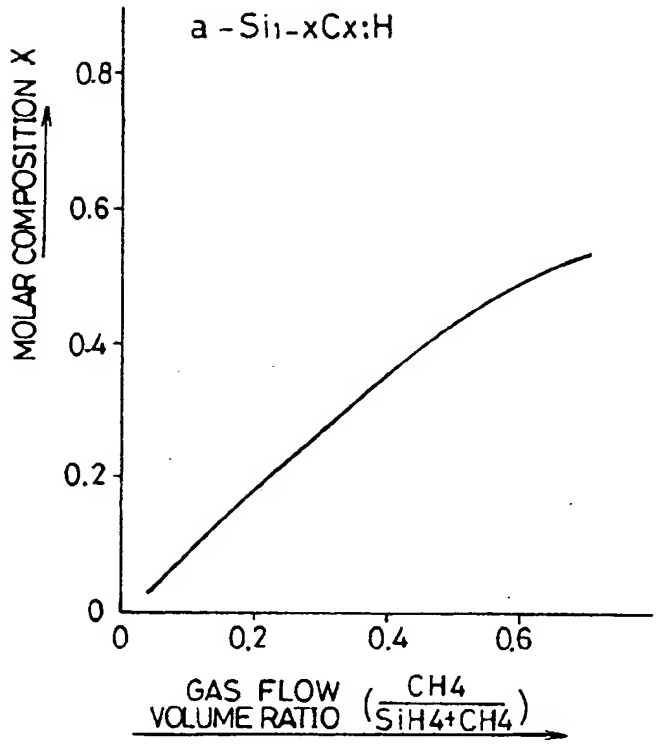

a-Si1-xCx:H
MOLAR COMPOSITION X
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
GAS FLOW VOLUME RATIO (CH4 / SiH4+CH4)

Fig. 4

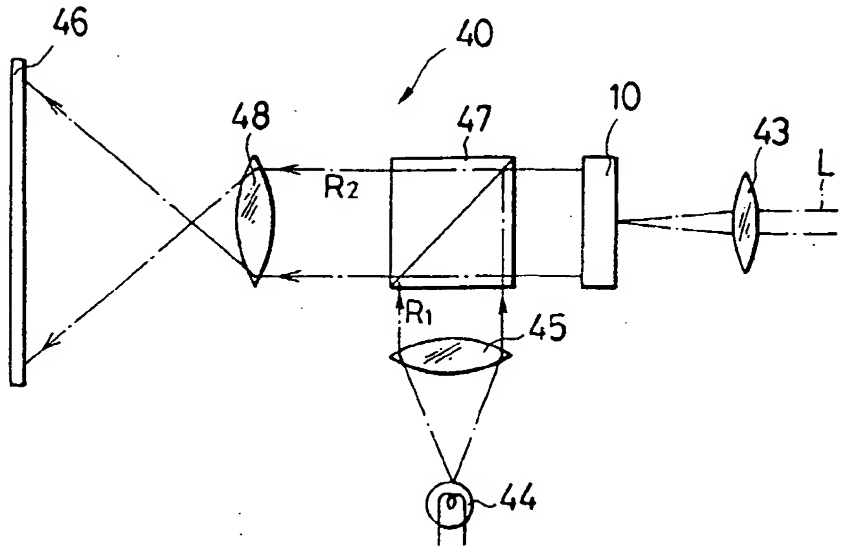

46
40
48
47
10
43
L
R2
R1
45
44

Fig.5

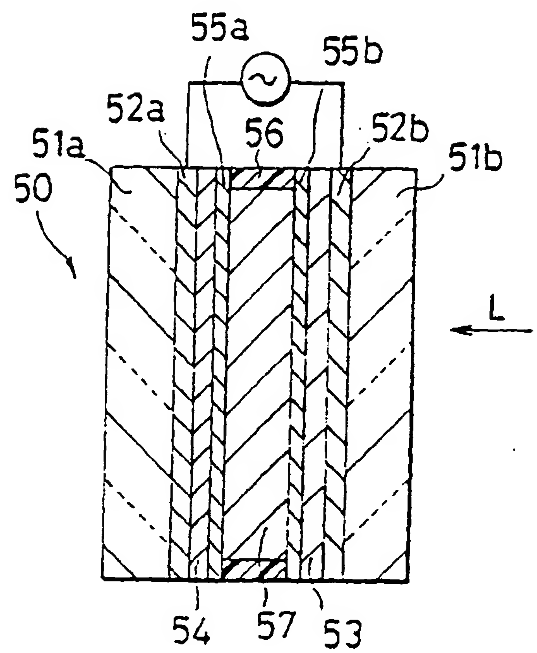
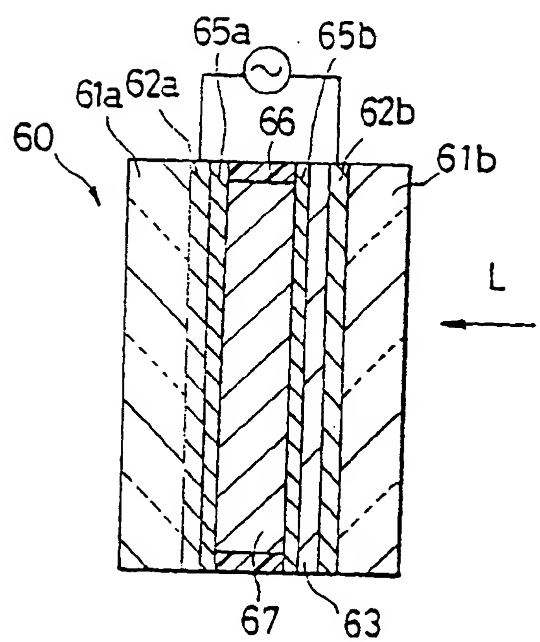

55a
55b
52a
56
52b
51a
51b
50
L
54
57
53

Fig.6


65a
65b
61a
62a
66
62b
60
61b
L
67
63